The Macroeconomic Impact of Money Market Disruptions

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Preliminary

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The views expressed are solely those of the authors.

What do we do?

- Document some stylized facts on euro area money markets during the recent financial and sovereign crisis
- Build a DSGE model of bank liquidity management with secured and unsecured money markets, and collateralized central bank funding.
- Calibrate the model and use it to provide a macroeconomic assessment of the observed money market disruptions

Stylized facts

- Declining role of interbank markets for EA banks:
  - Interbank liabilities to assets: 30% before 2008, 20% by 2013
- Drying up of unsecured markets and shift to secured market funding Secured vs unsecured funding
- Increase in private haircuts on some sovereign bonds, far beyond the increase in ECB haircuts ECB vs private haircuts
- Fears of deposit runs in some stressed countries.
  - In May 2012, *"Greek depositors withdrew 700 million euros from banks on Monday" [WSJ]*, i.e. 0.4% of total deposits in one day.
- Increased recourse to central bank funding Eurosystem funding
  - Eurosystem funding to MFI's deposit liabilities: since 2008, 0% in core countries, >25% in peripheral countries

The environment

- Households
  - Infinitely-lived; hold money and deposits; consume and work
- Firms
  - Final good producers: owned by banks, use labor and capital (Cobb Douglas technology)
  - Capital good producers: buy existing capital from banks; create new capital goods; sell it back to banks
- Government
  - Finances expenses through labor taxed and long-term debt.
  - Uses income taxes to stabilize debt at targeted level $\overline{B}^*$.

The central bank

- Hold discount bonds issued by govt, B_t^C, with fixed repayment rate, κ, and price Q_t.
- Provides collateralized loans to bank l, $F_{t,l} \leq \eta_t \; Q_t B_{t,l}^F$, applying haircut η_t.
- Issues money and transfers seigniorage to govt
- CB balance sheet at t:

Assets	**Liabilities**
$Q_t^F \overline{F}_t$ (loans to banks)	$\overline{M}_t$ (currency in circulation)
$Q_t B_t^C$ (govt bond holdings)	S_t(seigniorage)

- CB chooses $\overline{M}_t, B_t^C, Q_t^F$, and η_t

Banks: timing

- Morning:
  - a "type"shock realizes. With prob ξ_t, a bank is "connected", can access unsecured mkt
  - after type łknown, choice of assets (capital $k_{t,l}$, bonds $B_{t,l}$, money $M_{t,l}$, and dividends $\phi N_{t,l}$) and liabilities (deposits $D_{t,l}$, CB loans $F_{t,l}$, and net worth $N_{t,l}$)
- Afternoon (liquidity management):
  - iid liquidity shock: deposits reshuffled across banks
  - C(onnected) banks: riase liquidity in unsecured mkt
  - U(nconnected) banks: raise liquidity in secured mkt up to $\widetilde{\eta}_t Q_t (B_{t,u} - B^F_{t,u})$
- End of period:
  - Reverse liquidity shock occurs, loans are repaid
  - All banks return earnings to mother bank, which allocates net worth equally to all banks in $t+1$.

Banks: "morning" problem

Maximize end-of period bank value

$$\tilde{V}_{t,l} = \tilde{\psi}_{t,k} P_t k_{t,l} + \tilde{\psi}_t B_{t,l} + \tilde{\psi}_{t,M} M_{t,l} - \tilde{\psi}_{t,D} D_{t,l} - \tilde{\psi}_{t,F} F_{t,l}$$

s.t. for $l = c, u$,

$$\begin{aligned} V_{t,l} &\geq \lambda \left(P_t k_{t,l} + Q_t B_{t,l} + M_{t,l} \right) \\ P_t k_{t,l} + Q_t B_{t,l} + \phi N_t &= D_{t,l} + Q_t^F F_{t,l} + N_t \\ F_{t,l} &\leq \eta_t Q_t B_{t,l}^F \\ 0 &\leq B_{t,l} - B_{t,l}^F \end{aligned}$$

and, for U(nconnected) banks $l = u$, afternoon constraint:

$$\omega^{\max} D_{t,u} - M_{t,u} \leq \widetilde{\eta}_t Q_t \left(B_{t,u} - B_{t,u}^F \right)$$

Foreign sector

- Foreign sector allows U banks to change their collateral position independently from the govt's stock of debt.
- Foreign demand for domestic bonds:

$$B_t^W = P_t \left[\varkappa - \frac{1}{\varrho} \log Q_t \pi_t \right],$$

Analysis: steady state

- Analytical characterization of three different cases:
  - "Normal"times (all banks unconstrained)
  - Binding afternoon constraint for U banks, no CB funding
  - Binding afternoon constraint for U banks, CB funding

Case 1: "normal" times (all banks unconstrained)

- Slack afternoon constraint for U banks
- C and U banks have identical values
- Banks do not borrow from the CB, do not hold money, $F_l = M_l = 0$
- Returns on capital and bonds equalized:

$$\tilde{\psi}_k = \frac{\tilde{\psi}_b}{Q}$$

Case 2: Binding afternoon constraint, no CB funding

- Binding afternoon constraint for U banks. Requires that

$$\tilde{\psi}_k > \frac{\tilde{\psi}_b}{Q}$$

- U banks hold bonds for their collateral value
  - U banks hold both bonds and capital
  - C banks do not hold bonds

- Sufficient condition for no CB funding: private haircuts sufficiently low relative to CB funding cost, $\widetilde{\eta} \geq \eta Q^F \omega^{\max}$

- U banks may hold cash to relax the afternoon constraint (self-insurance)

Case 3: Binding afternoon constraint, CB funding

- Borrowing from CB requires afternoon constraint to bind:

$$\omega^{\max} D_u = \widetilde{\eta} Q \left(B_u - B_u^F \right) + M_u$$

- Increasing deposits further tightens afternoon constraint
- For low $\widetilde{\eta}$ and Q_F and η sufficiently close to 1, U banks top up deposit funding with CB funding in the morning
- U banks then hold money M_u to cover afternoon withdrawals

Calibration

- Key parameters:
  - Fraction of 'connected' banks, ξ: 0.42 pre-crisis. Euro Area Money Market Survey.
  - Max withdrawal as share of deposits, $\omega^{\max}$: 0.1. Info embedded in Liquidity Coverage Ratio: HQLA able to cover 30-days liquidity needs under stress over total assets.
  - Private and ECB haircuts, $\widetilde{\eta}$ and η: 0.97. Data from LCH Clearnet and ECB for 2010.

- Six free parameters: ϕ, λ, χ, g, B^C, $\overline{B}^*$. Set to minimize squared log-deviation of six model predictions from empirical pre-crisis counterparts

Variable	**Data**	**Model**
Debt/GDP	0.57	0.61
Bank leverage	6.00	5.81
Loan spread (annual)	0.021	0.021
Share bonds unconnected banks	0.23	0.23
Share bonds foreign sector	0.64	0.61
Inflation (annual)	0.020	0.021

- List all parameter values

Unsecured money market freeze

- Comparative statics: reduced access to unsecured mkt

  Results: unsecured market freeze

- Reducing share of unsecured to secured market volumes from 42% to 24% generates an output contraction of 0.4%

- The same reduction when fears of deposit withdrawals double ($\omega^{\max}$ increases from 0.1 to 0.2) generates an output contraction of 4%

Secured money market freeze

- Comparative statics: decrease in $\widetilde{\eta}$ Results: secured market freeze
- Increase in private haircuts from 3% to 25% generates an output contraction of 0.3% (0.8% when $\omega^{\max} = 0.2$)
- Impact would be much more severe in absence of CB

Run on deposits

- Comparative statics: increase in ω_{max} Results: depositor run
- Increase in customer withdrawals from 10% to 20% of total deposits generates an output contraction of 3%

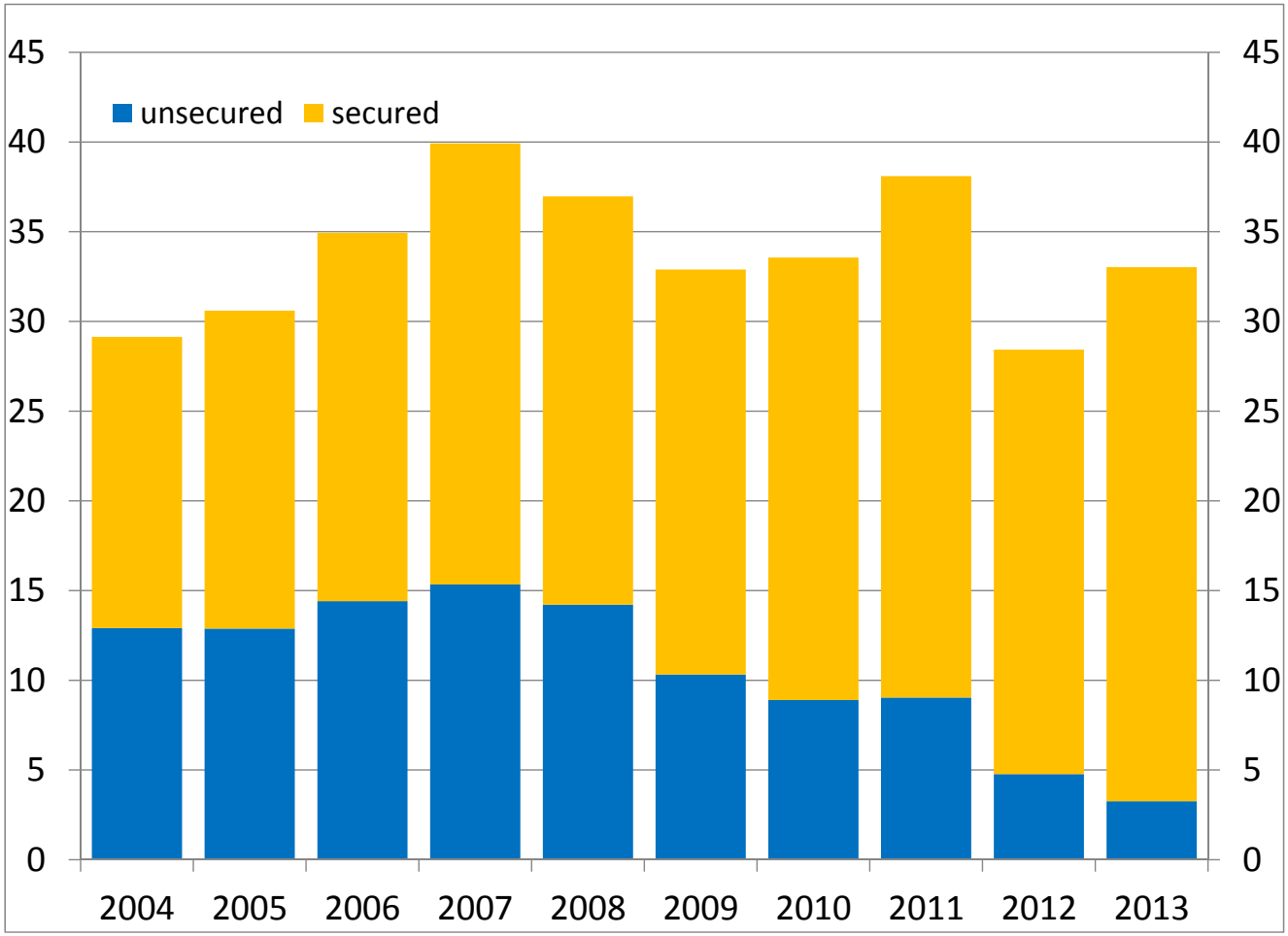
Conclusions

- Money markets help manage short-run liquidity needs
- Calibrated DSGE model to assess the macroeconomic impact of money market frictions
- Three exercises, aiming to capture unsecured and secured money market disruptions, and depositor runs
  - Output contractions are sizeable (0.4% to 4% in our scenarios)

To do list

- Policy experiments:
  - Shortage of safe assets
  - Enlarging the set of collateral accepted at the CB
  - Asset purchases by the CB

Quarterly turnover in the euro money market



Source: Euro Area Money Market Survey. Cumulative quarterly turnover in the euro m
market (EUR trillion).The panel comprised 98 euro area credit institutions.

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ECB vs private haircuts on sovereign bonds

	ECB		Private	
	CQS1-2	CQS3	Germany	Portugal
2010	2.8	7.8	2.7	8.1
2011	2.8	7.8	3.0	10.1
2012	2.8	7.8	3.0	80.0
2013	2.8	7.8	3.0	80.0
2014	2.2	9.4	3.0	80.0

Data source: ECB dataset and LCH Clearnet

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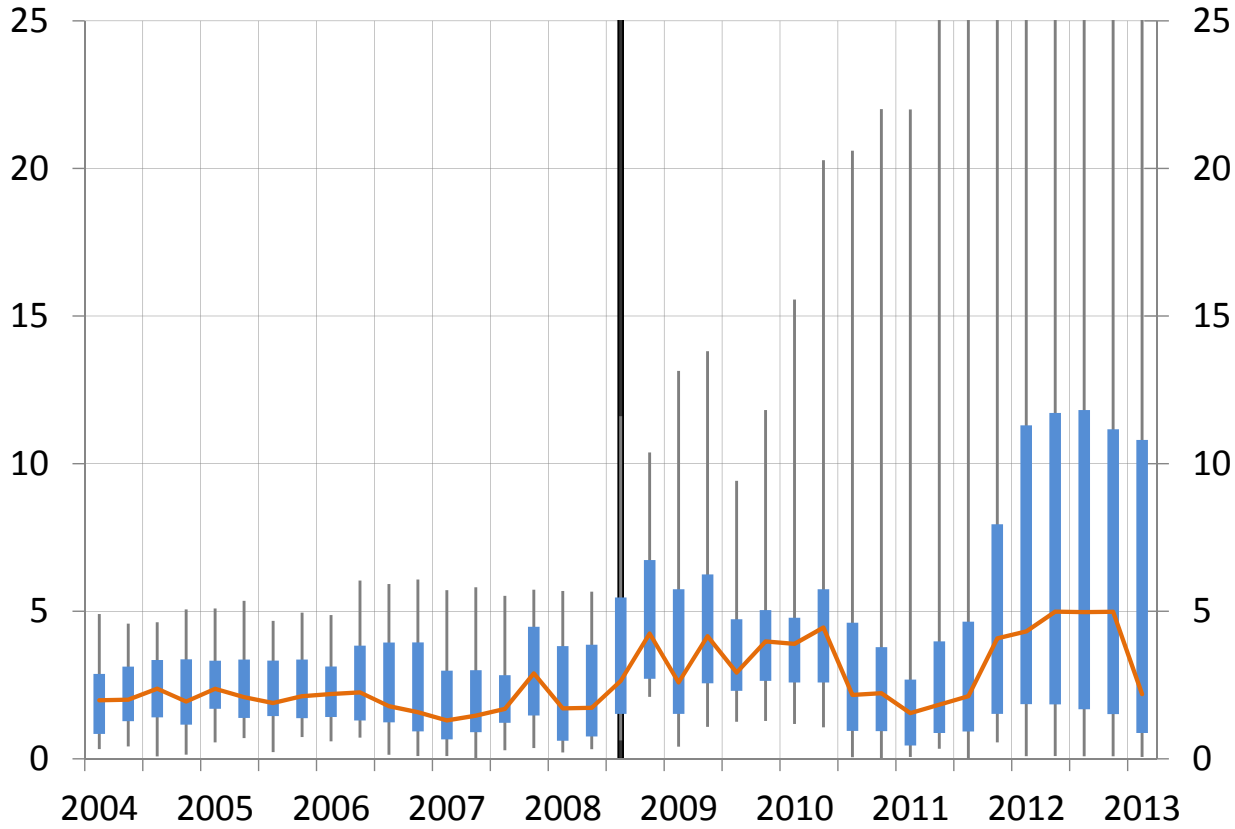
Eurosystem funding in total deposit liabilities



Source: ECB dataset, own calculations.

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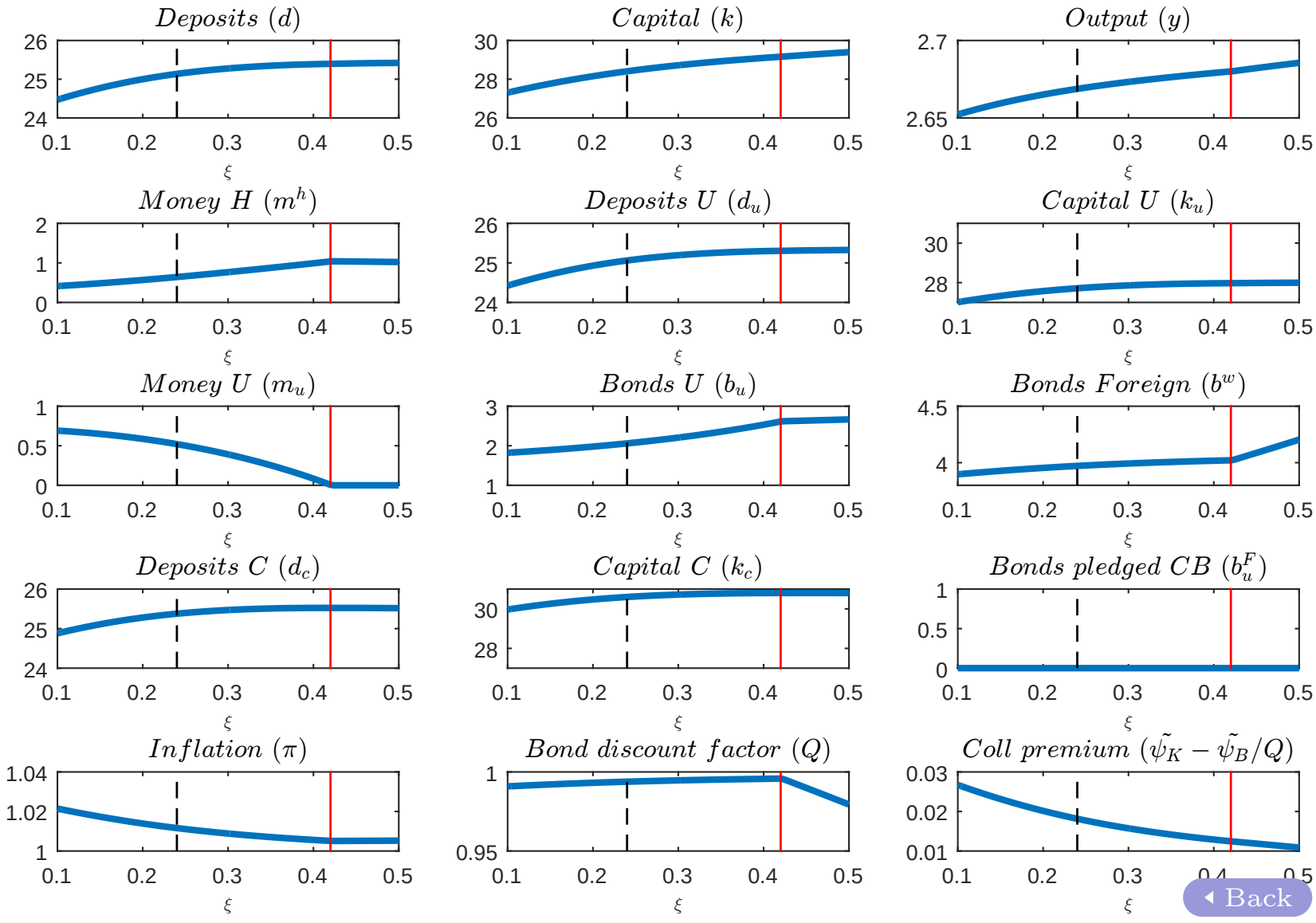
Comparative statics: unsecured money market freeze



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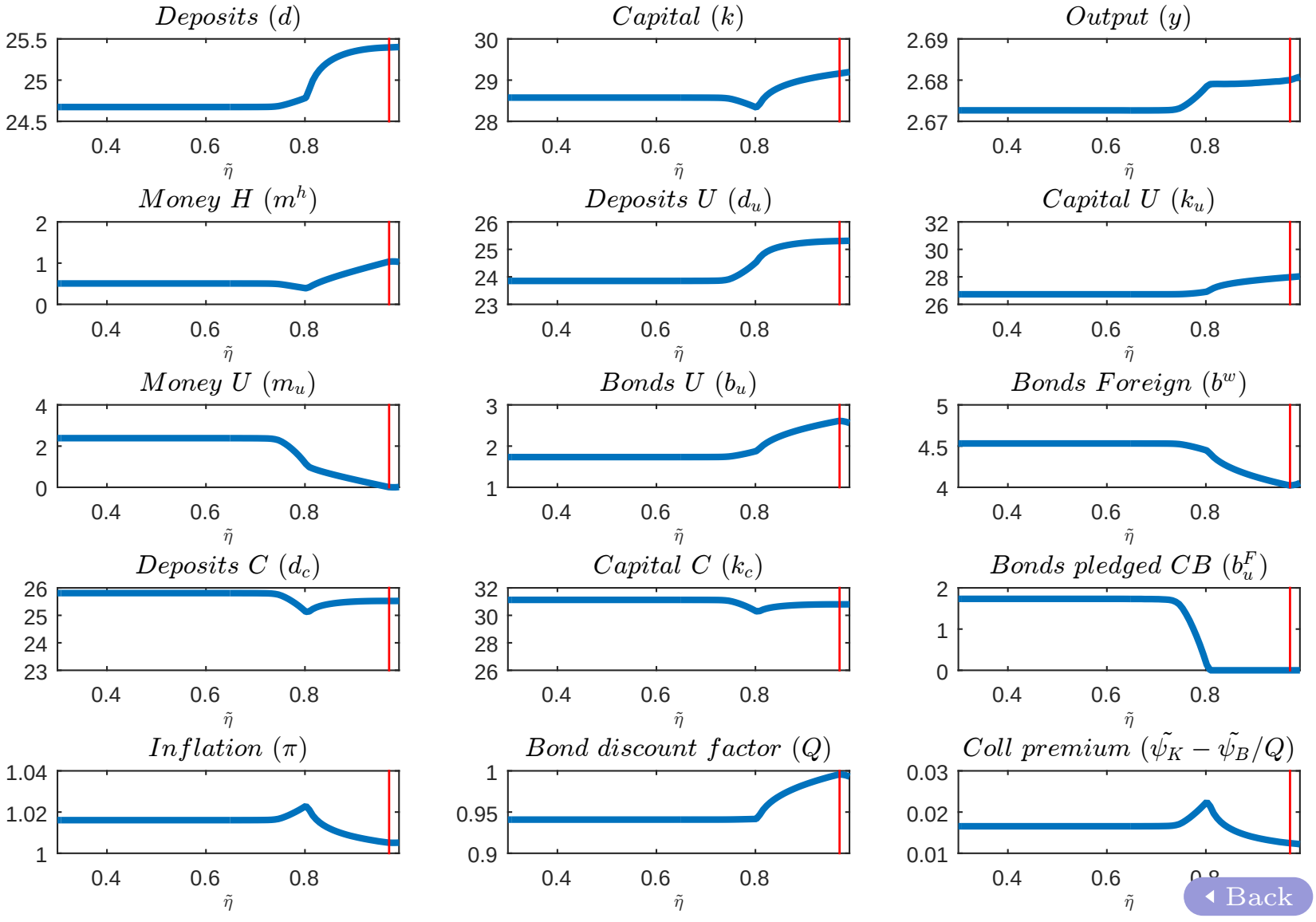
Comparative statics: secured money market freeze



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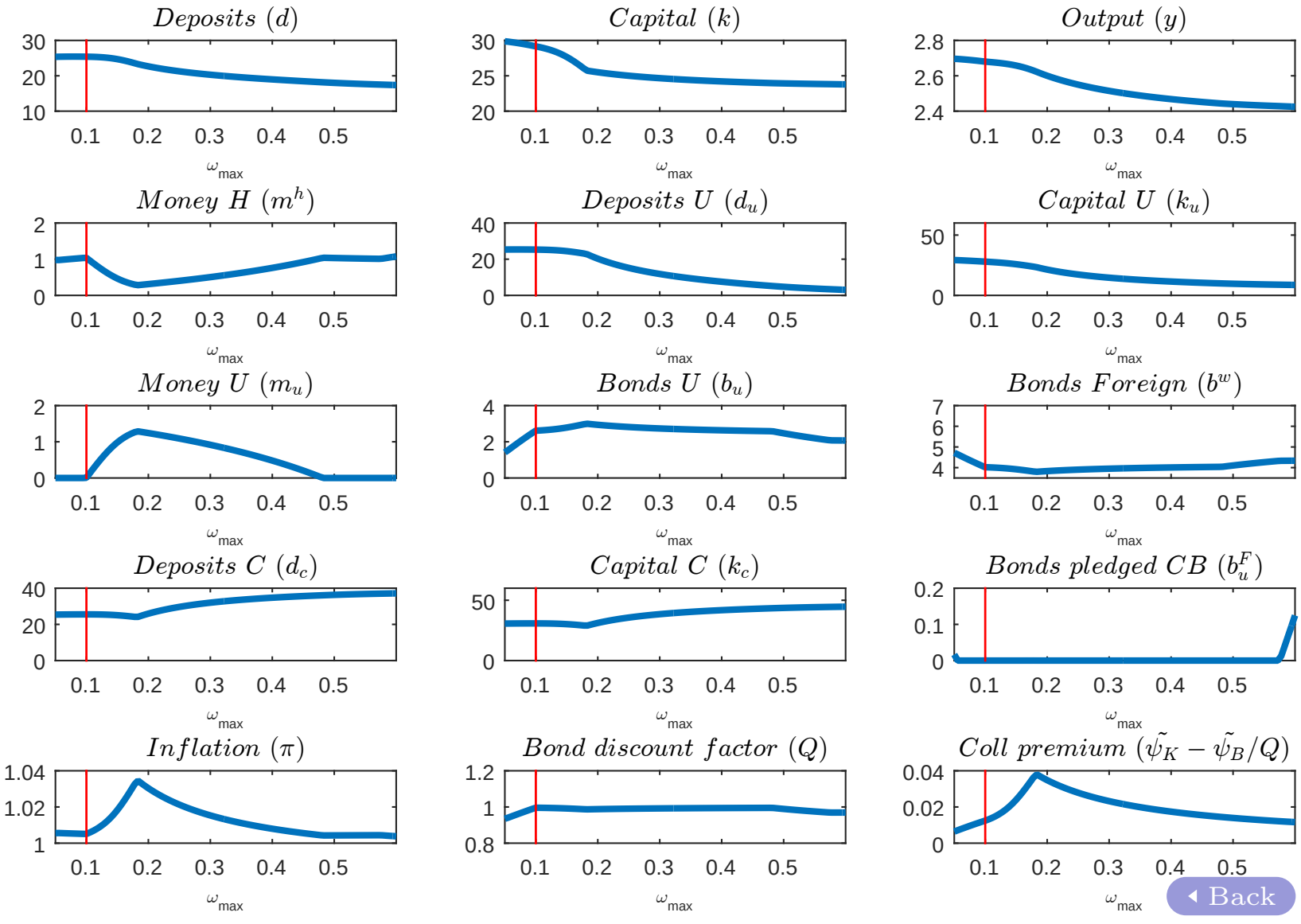
Comparative statics: increased risk of depositor run



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List of all parameter values

Parameter	Description	Value
θ	Capital share	0.33
δ	Depreciation rate	0.02
β	Discount rate H	0.999
χ	Coeff money in utility	0.0022
g	Government spending	1.0081
κ^{-1}	Aver maturity bonds	9
ϕ	Fraction net worth as dividends	0.0191
ξ	Fraction 'connected' banks	0.42
$\widetilde{\eta}$	Private haircut on bonds	0.97
η	CB haircut on bonds	0.97
λ	Run-away coefficient	0.105
$\omega^{\max}$	Max withdrawal as share of deposits	0.3
B_C	Bonds held by central bank	0.711
ϱ	Parameter foreign bond demand	0.09

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